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A2D DSX D2D2
B2F FD F132 F205 F305 F311 F340
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(56) Documents Cited
GB 0723478 A **GB 0708359 A** **US 5558276 A**
US 5529809 A **US 3917168 A**

(58) Field of Search
UK CL (Edition P) **A5G GD GF , B2F FD FHB**
INT CL^6 **A61L 9/02 9/03 9/14 , A63J 5/02 , B05B 7/06 7/16**
Online: WPI

(54) Fogging machine

(57) A fogging machine comprises heating apparatus for heating air, atomisation means 9 housing a nozzle 10 for atomising a liquid 5 and a hose 6 or the like for transporting the liquid from a reservoir to the atomisation means. In use, liquid flows through the nozzle, and, upon exiting, is combined with the heated air 17 and is atomised into droplets, the diameter of the droplets being dependent upon one or more of the nozzle size, the back-pressure in the hose or the like, the flow rate therein and the temperature and flow rate of the heated air. The atomisation means preferably includes a funnel 11 with apertures 16 through which the heated air passes so that the hot air mixes with the liquid within the funnel.

The fog produced by this machine may be used as a sprout suppressant (eg for potatoes), a biocide, a disinfectant or an insecticide.

The fogging machine is preferably mobile (Fig 1).

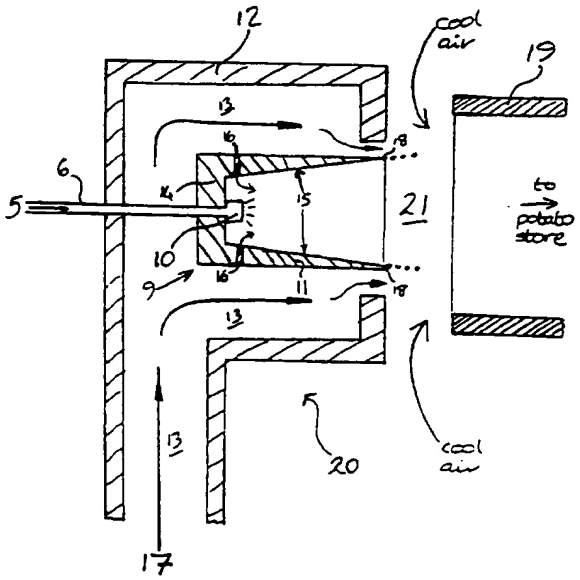

FIGURE 2

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.
The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1995
This print takes account of replacement documents submitted after the date of filing to enable the application to comply with the formal requirements of the Patents Rules 1995

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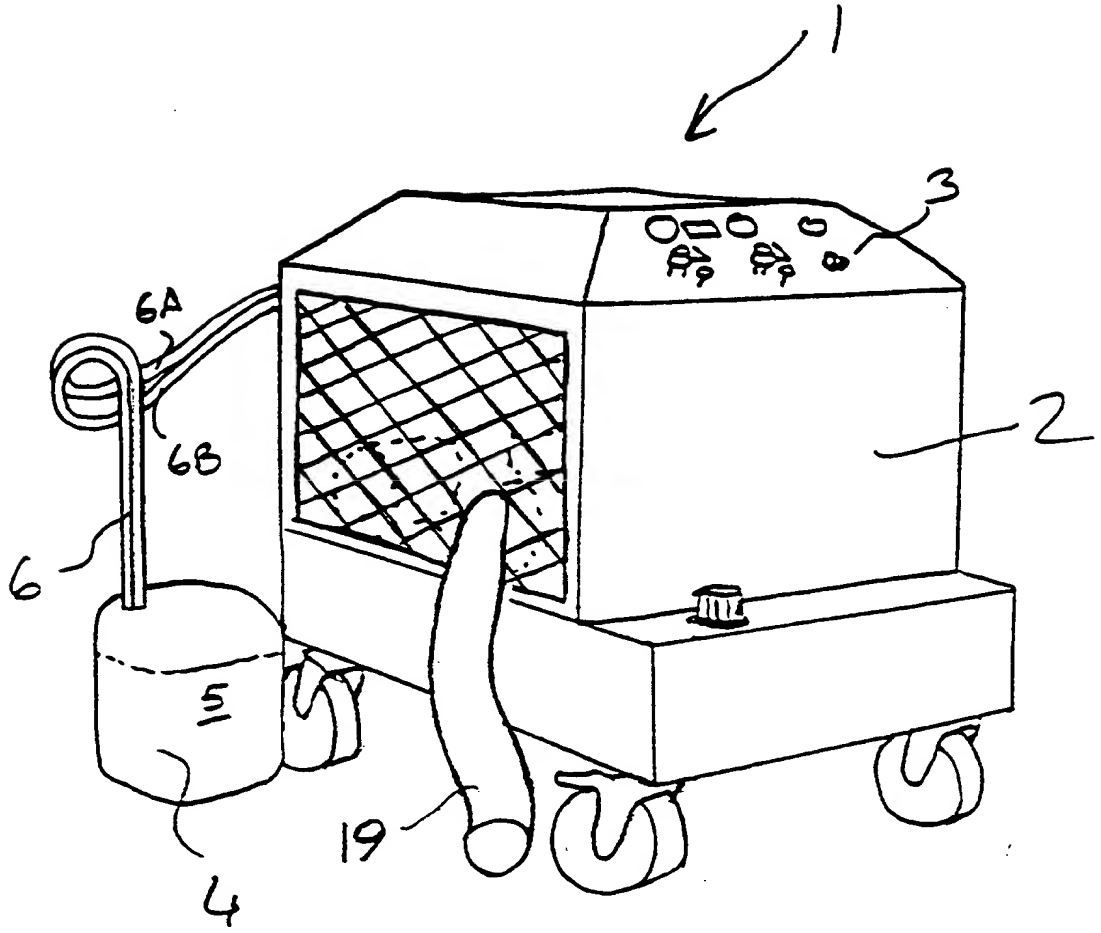

FIGURE 1

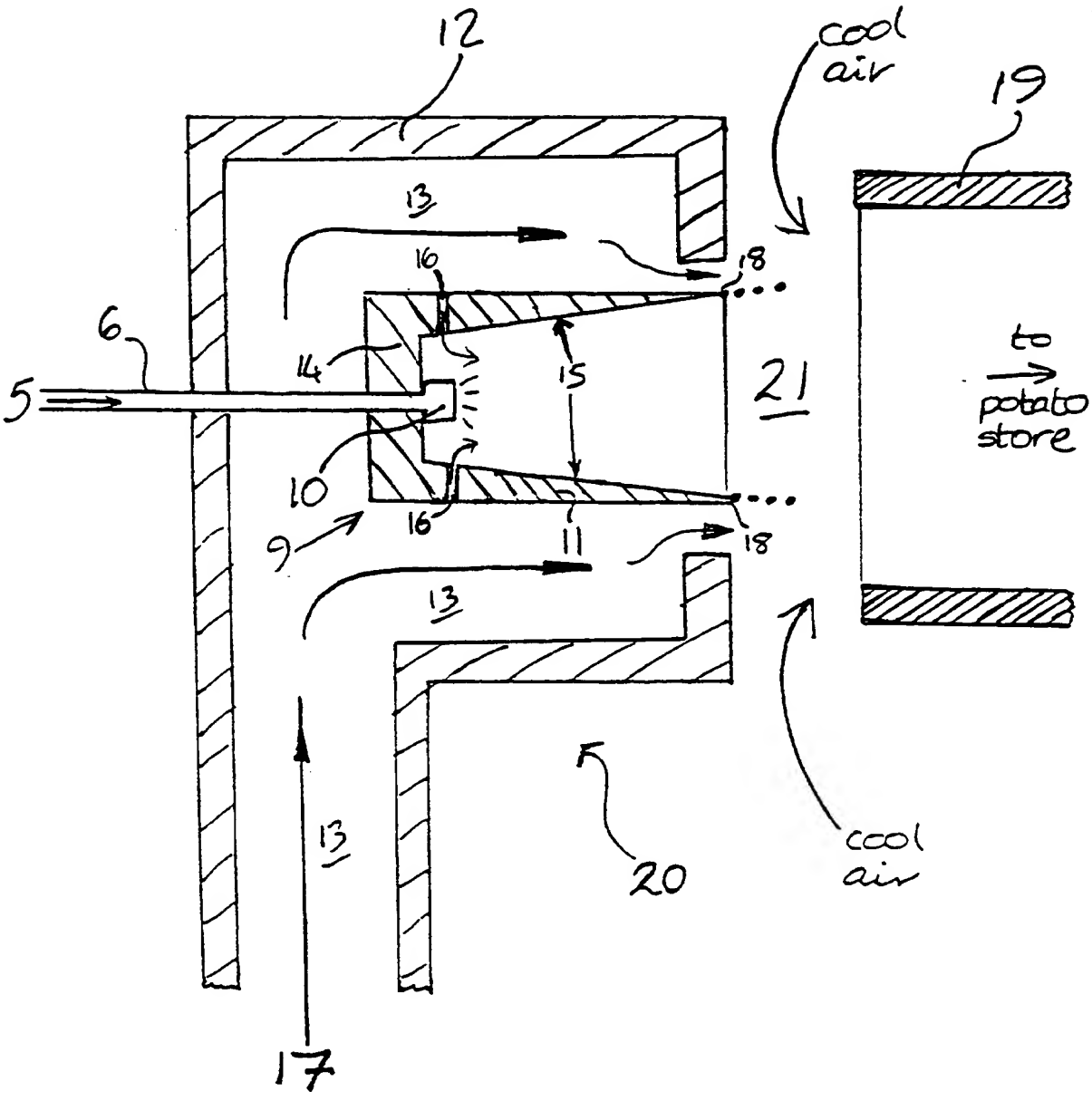
12
cool air
19
13
16
18
6
14
15
21
to potato store
5
10
16
18
9
11
13
13
20
cool air
17

FIGURE 2

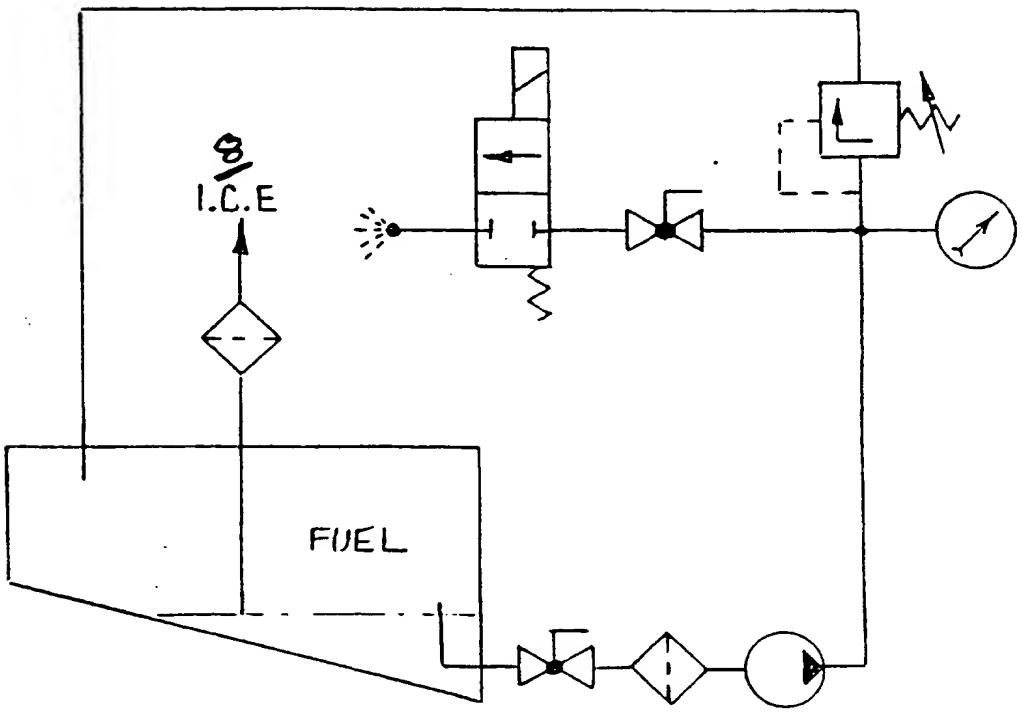

FIGURE 3

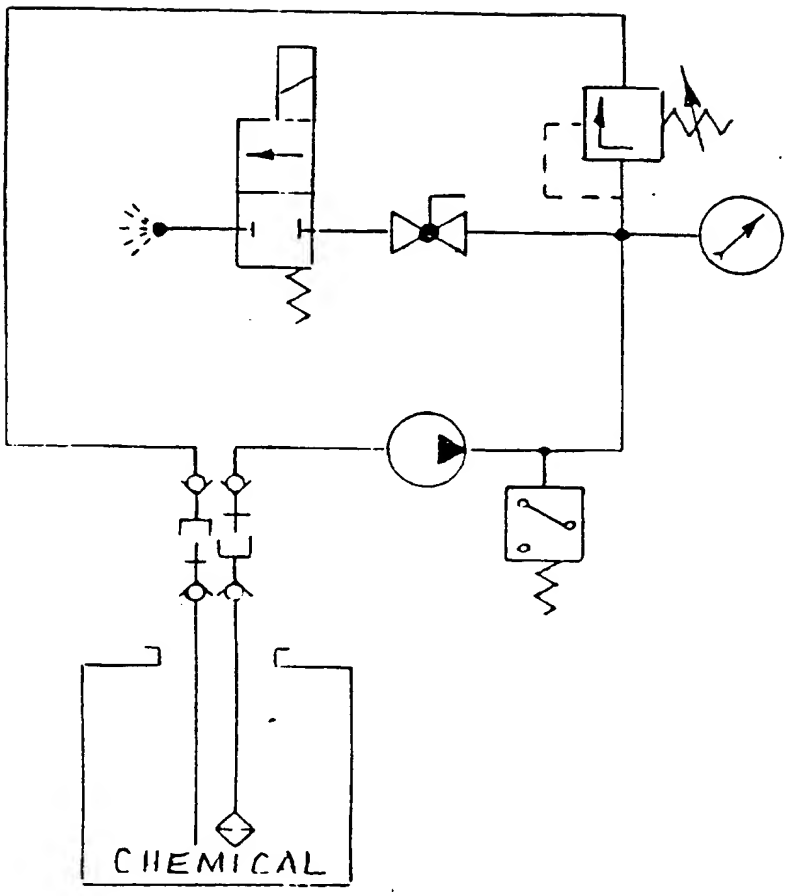

FIGURE 4

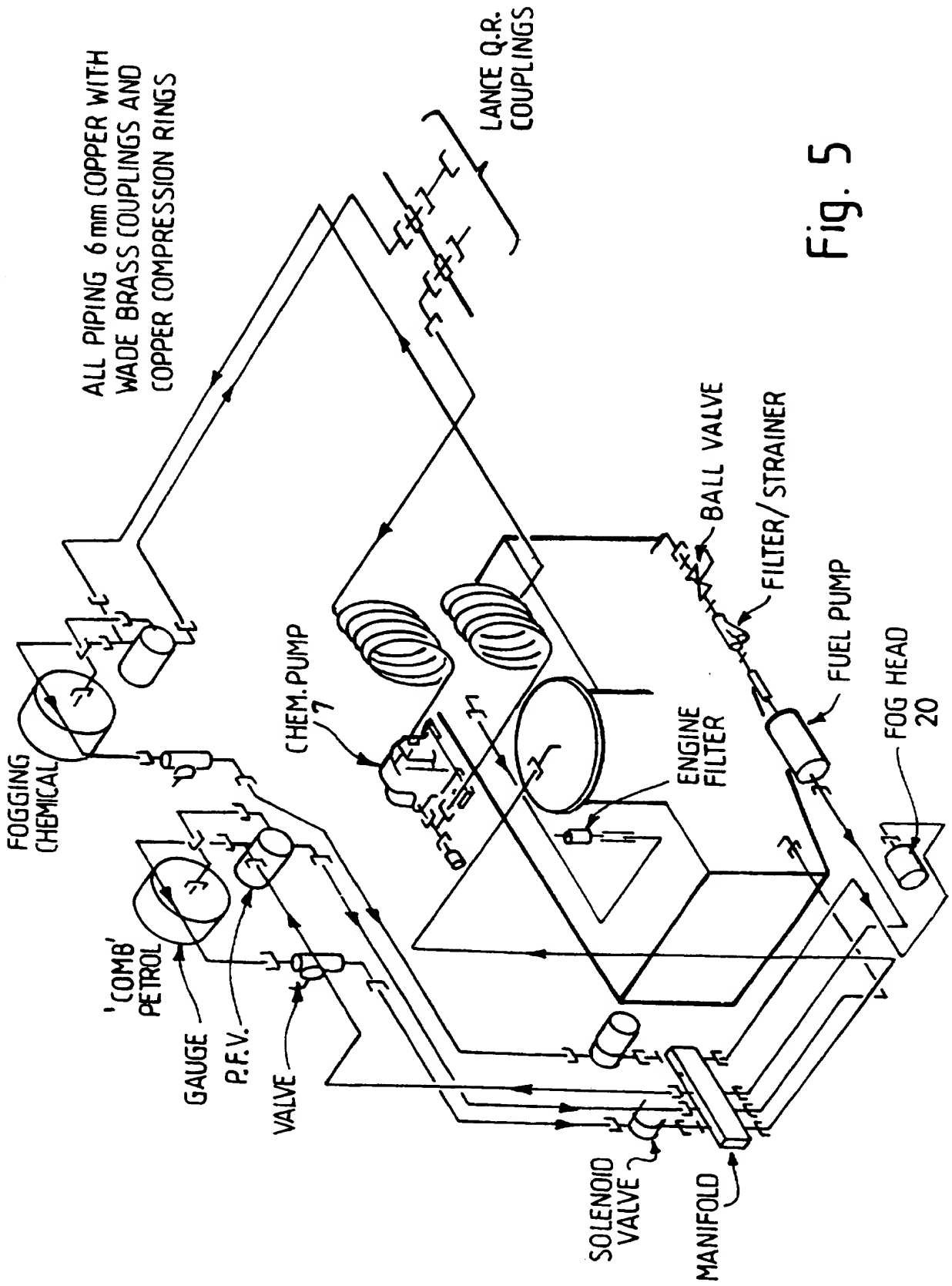
ALL PIPING 6 mm COPPER WITH WADE BRASS COUPLINGS AND COPPER COMPRESSION RINGS
LANCE Q.R. COUPLINGS
FOGGING CHEMICAL
'COMB' PETROL
GAUGE
P.F.V.
VALVE
CHEM. PUMP 7
BALL VALVE
FILTER/STRAINER
FUEL PUMP
ENGINE FILTER
FOG HEAD 20
SOLENOID VALVE
MANIFOLD

Fig. 5

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FOGGING MACHINE

Field of the Invention

This invention relates to the field of thermal fog generators (or "fogging machines") for producing a fine mist or fog of droplets in particular, but not exclusively for use in disinfecting stored crops, for example potatoes.

Background to the Invention

Root crops such as potatoes are generally stored in a temperature-controlled environment after harvesting. It is imperative that the potatoes are prevented from sprouting which they are naturally inclined to do in such storage conditions and which results in spoilage of the crop.

A known method of reducing the likelihood of sprouting is the application of chemical sprout suppressants and/or biocides to the crop whilst in storage. In order to be effective, the chemical must be evenly distributed throughout the crop which can be difficult with irregularly-shaped crops such as potatoes compounded by the fact that the storage areas are generally very large.

The sprout suppressants are typically dispersed using a fogging machine which heats the liquid chemicals and atomises them into a fine mist or fog of droplets which is then dispersed into the crop storage area, covering all surfaces of the crop therein.

Conventionally the atomised droplets are formed using a "metering disc" or "orifice plate" comprising a disc or plate having an orifice therein of known

size through which the liquid passes to regulate the flow thereof. The controlled flow of liquid is then atomised through heating.

It is advantageous to produce a fog of as small a droplet size as possible to maximise the effectiveness of crop coverage. Conventional fogging machines suffer from the disadvantage that in order to produce smaller droplets, the machine must operate at a higher temperature during the atomisation process thus using more energy. This problem is increased by the fact that potato stores, for example, are generally maintained at a relatively low ambient temperature, for example 4°C, and hence much energy is wasted in heating the chemical to high temperatures for dispersal and then cooling the store again in order to maintain the potato store at the correct temperature.

It is often desirable to vary the droplet size in the fog, depending upon the conditions in which the machine is being used. This is inconvenient and time-consuming in a conventional fogging machine since the metering disc needs to be physically removed and replaced (with one of a different orifice size) in order to achieve this.

It is thus an object of the present invention to provide a fogging machine which is capable of producing small droplets at operating temperatures lower than those of conventional fogging machines.

It is a further object of the invention to provide a fogging machine which is capable of producing droplets of readily controllable size.

Summary of the Invention

According to the present invention, in its broadest aspect, there is provided a fogging machine comprising heating apparatus for heating air, atomisation means for atomising a liquid or aqueous chemical into droplets so as to form a fog and a hose or the like for transporting the liquid or aqueous chemical from a reservoir to the atomisation means, characterised in that the atomisation means includes a nozzle, on the exiting of which the liquid or aqueous chemical is combined with the heated air and is atomised into

droplets, the diameter of which droplets is dependent upon one or more of the nozzle size, the back-pressure in the hose or the like, the flow rate therein and the temperature and flow rate of the heated air.

Preferably, in use, on exiting the nozzle, the atomised liquid or aqueous chemical is heated by combination with the hot air, causing further atomisation of said chemical, this being the second stage of a two-stage atomisation process (the first stage being described in the preceding paragraph). This two-stage atomisation process is advantageous because it reduces the average droplet diameter (in comparison to a conventional one-stage process).

In a preferred form, the atomisation means further comprises a funnel which substantially surrounds said nozzle so as to direct the chemical droplets exiting therefrom. Advantageously, the funnel includes a plurality of apertures which, in use, permit the passage of hot air therethrough so as to mix with the chemical droplets substantially within the confines of said funnel. Preferably, the apertures are tangential to the surface of the funnel and are so sized and shaped as to cause turbulence within the confines of the funnel which facilitates further atomisation of the chemical droplets therein. Ideally, said apertures are equi-spaced.

In a further preferred form, the body of said funnel is tapered such that, in use, liquid or aqueous chemical impinging upon the inner surfaces of said funnel tends to run to the tapered edges thereof, from where it leaves the surfaces of the funnel as droplets.

Advantageously, the hose provided to transport the fog from the exit of the atomisation means for dispersal is spaced from said exit so that cool air can enter and mix with the fog before dispersal thereof.

Ideally, some or all of any excess liquid or aqueous chemical is transported back to the reservoir for re-circulation through the system.

It will be appreciated that the invention is intended to include within its

scope a fogging machine substantially as described herein with reference to and as illustrated by any appropriate combination of the accompanying drawings.

Brief Description of the Drawings

Preferred embodiments will now be more particularly described, by way of example only, with reference to the accompanying drawings wherein:

Figure 1 is a perspective view of a fogging machine embodying the present invention;

Figure 2 is a cross-sectional view of the fog head showing the atomisation means;

Figure 3 is a schematic of the combustion circuit;

Figure 4 is a schematic of the chemical circuit; and

Figure 5 is an isometric schematic of the fogging machine's piping arrangement.

Description of the Preferred Embodiments

Referring to Figure 1, the fogging machine 1 of the present invention comprises a caster-mounted housing 2 having a control panel 3. The housing 2 could alternatively be a palletised cage or road trailer mounted unit.

Reservoir 4 contains the liquid or aqueous chemical(s) which it is intended to turn into fog. In a potato storage application, these chemicals are typically sprout suppressants and biocides carried in water (or other solvent carrier). It will be appreciated that other chemicals may well be used in different applications. The liquid or aqueous chemical will be generally designated by reference numeral 5 in this specification.

Hose 6 is used as a conduit for chemical 5 between reservoir 4 and the body of the fogging machine 1. The hose is divided into two portions, 6A 6B, since chemical 5 can, in use, travel in either direction and hence a hose for each direction is required. Chemical 5 is transported using pump 7 (shown in Figure 5).

Any overspill of chemical 5 at pump 7 is returned to reservoir 4 for recirculation through the system. The return of some of chemical 5 to reservoir 4 has the added advantage of agitating the chemical(s) therein.

In use, a blower driven by an internal combustion engine 8 pumps air into a combustion chamber where it is heated by means of fuel injected into the chamber and ignited by a spark. The pressurised hot air flow 17 is then transported to fog head 20 (shown in Figure 2).

Figure 2 shows the fog head 20 which contains atomisation means 9. The atomisation means comprises a nozzle 10 attached to the end of hose 6 through which chemical 5 arrives and a funnel 11 which is, preferably, screwed to the nozzle so as to substantially surround it. Funnel 11 is, in turn, substantially surrounded by atomiser housing 12 with air passages 13 therebetween.

Funnel 11 is preferably conical or cylindrical and comprises a backplate 14 through which hose 6 passes and tapered inner surfaces 15 which taper away from backplate 14 as shown in Figure 2.

The tapered surfaces 15 of funnel 11 are provided with apertures 16 which are preferably equi-spaced around the periphery of funnel 11 and are tangential when funnel 11 is viewed end-on.

In use, chemical 5 arrives at nozzle 10 via hose 6. The presence of nozzle 10 creates a back-pressure in hose 6 which results in atomisation of chemical 5 as it exits the nozzle 10. Hot air flow 17 is introduced into air passages 13 and this hot air is able to enter funnel 11 by means of apertures 16. On entering funnel 11, the hot air creates turbulence within the confines of

funnel 11, mixing with atomised chemical 5 causing further atomisation and hence smaller droplet size. Chemical 5 thus goes through a two-stage atomisation process: firstly immediately on exiting nozzle 10 and secondly in combination with hot air flow 17.

Any of chemical 5 which impinges on tapered inner surfaces 15 tends to run towards end points 18, partly because of the shape of surfaces 15 but also because of the direction of hot air flow 17. On reaching end points 18, chemical 5 forms droplets which leave surface 15 of the funnel as indicated in Figure 2. In this way, chemical 5 is atomised and directed to best effect.

On leaving atomisation means 9, the fog passes into fogging hose 19 where further atomisation occurs as the chemical 5 mixes with the hot, turbulent air flow 17. On exiting fogging hose 19, the fog is dispersed into the environment in which fogging machine 1 is situated. Fogging hose 19 may project out of the housing 2 (by up to, for example 3m) in order to facilitate the directing of the fog.

Fogging hose 19 is necessarily of greater diameter than previously-described hoses 6 (for example 10cm diameter). In a preferred form, shown in Figure 2, there may be a gap 21 between atomisation means 9 and fogging hose 19. Cool air can thus mix with atomised chemical 5 as shown by the arrows in Figure 2, the cool air being sucked into the flow of atomised chemical 5 by the Venturi effect, thus increasing the flow, decreasing the temperature and decreasing the velocity of the atomised chemical fog.

The lowering of the fog temperature is of particular importance given that the fog is intended to be dispersed into an already cooled environment such as a potato store. This therefore reduces the energy required to maintain the store at its correct temperature since the fog is not at such a relatively high temperature as that produced by conventional fogging machines.

The apparatus of the present invention may be readily used in applications other than crop storage, for example disinfection and/or chemical insect control in, among others, theatres, and poultry/livestock sheds etc.

CLAIMS

1. A fogging machine comprising heating apparatus for heating air, atomisation means for atomising a liquid or aqueous chemical into droplets so as to form a fog and a hose or the like for transporting the liquid or aqueous chemical from a reservoir to the atomisation means, characterised in that the atomisation means includes a nozzle, on the existing of which the liquid or aqueous chemical is combined with the heated air and is atomised into droplets, the diameter of which droplets is dependent upon one or more of the nozzle size, the back-pressure in the hose or the like, the flow rate therein and the temperature and flow rate of the heated air.

2. A fogging machine as claimed in Claim 1 wherein the atomisation means further comprises a funnel which substantially surrounds said nozzle so as to direct the chemical droplets existing therefrom.

3. A fogging machine as claimed in Claim 2 wherein the funnel includes a plurality of apertures which, in use, permit the passage of hot air there through so as to mix with the chemical droplets substantially within the confines of said funnel.

4. A fogging machine as claimed in Claim 3 wherein said apertures are tangential to the surface of the funnel and are so sized and shaped as to cause turbulence within the confines of the funnel which facilitates further atomisation of the chemical droplets therein.

5. A fogging machine as claimed in Claim 3 or Claim 4 wherein said apertures are equi-spaced.

6. A fogging machine as claimed in any of Claims 2-5 wherein the body of said funnel is tapered such that, in use, liquid or aqueous chemical impinging upon the inner surfaces of said funnel tends to run to the

tapered edges thereof, from where it leaves the surfaces of the funnel as droplets.

7. A fogging machine as claimed in any of the preceding claims wherein the hose provided to transport the fog from the atomisation means for dispersal is spaced from said exit so that cool air can enter and mix with the fog before dispersal thereof.

8. A two-stage atomisation process using a fogging machine substantially as described in any of the preceding claims wherein, on exiting the nozzle, the atomised liquid or aqueous chemical is heated by combination with the hot air, causing further atomisation of said chemical.

9. An atomisation process as claimed in Claim 8 wherein some or all of any excess liquid or aqueous chemical is transported back to the reservoir for re-circulation through the system.

10. A fogging machine as substantially described herein with reference to and as illustrated by any appropriate combination of the accompanying drawings.

11. An atomisation process substantially as described herein with reference to and as illustrated by any appropriate combination of the accompanying drawings.

The Patent Office

9

Application No: GB 9621793.0 **Examiner:** Gavin Dale
Claims searched: 1-11 **Date of search:** 13 January 1998

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): A5G (GD, GF); B2F (FD, FHB)

Int Cl (Ed.6): B05B 7/06, 7/16; A61L 9/02, 9/03, 9/14; A63J 5/02

Other: Online: WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 0723478	(STANDARD OIL DEVELOPMENT) See Fig 1 (provisional specification) & page 3 lines 38-46	1 at least
X	GB 0708359	(STEEL COMPANY OF WALES) See Fig 2 & page 5 lines 8-15	1 at least
X	US 5558276	(BARRETT) See column 2 lines 16-19 & column 7 lines 46-56	1 at least
X	US 5529809	(GLOVAN et al) See Fig 1 & column 5 lines 24-49	1 at least
X	US 3917168	(TENNEY) See Fig 5, column 5 lines 60-62 & column 6 lines 2-19	1 at least

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
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INTERNATIONALER RECHERCHENBERICHT

Internationales Aktenzeichen
PCT/EP 99/09469

A. KLASSIFIZIERUNG DES ANMELDUNGSGEGENSTANDES
IPK 7 B05B7/00 B65B55/10

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IPK 7 B05B B65B A61L

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C. ALS WESENTLICH ANGESEHENE UNTERLAGEN

Kategorie°	Bezeichnung der Veröffentlichung, soweit erforderlich unter Angabe der in Betracht kommenden Teile	Betr. Anspruch Nr.
A	DE 23 08 012 A (SULZER AG) 29. August 1974 (1974-08-29) Seite 5, Zeile 5 - Zeile 13; Abbildung 2	1
A	GB 2 318 294 A (SAM UNIFOG LIMITED) 22. April 1998 (1998-04-22) Seite 5, Zeile 27 -Seite 6, Zeile 15; Abbildung 2	1

☐ Weitere Veröffentlichungen sind der Fortsetzung von Feld C zu entnehmen

☒ Siehe Anhang Patentfamilie

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Datum des Abschlusses der Internationalen Recherche	Absendedatum des Internationalen Recherchenberichts
29. März 2000	07/04/2000

Name und Postanschrift der Internationalen Recherchenbehörde	Bevollmächtigter Bediensteter
Europäisches Patentamt, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Juguet, J

Formblatt PCT/ISA/210 (Blatt 2) (Juli 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/EP 99/09469

Patent document cited in search report	Publication date	Patent family member(s)	Publication dat
DE 2308012 A	29-08-1974	CH 560052 A	27-03-1975
GB 2318294 A	22-04-1998	NONE	